BELL WORK, 6-Mar-2017

Write a balanced equation for the reaction below:

Zinc and bromide react to for Zinc (II) Bromide

In series of trials a student recorded the following data when reacting Zinc and Bromide

	Trial A	**Trial B**
Mass of Zinc (M.M. 65g/mol)	5.00g	10.0g
Moles of Zinc		
Mass of Bromine (M.M. 160g/mol)	15.0g	18.0g
Moles of Bromine		
Mole ratio of zinc to Bromine		
What is the Limiting reagent		

Agenda

Pressure units and Kelvin

Objective

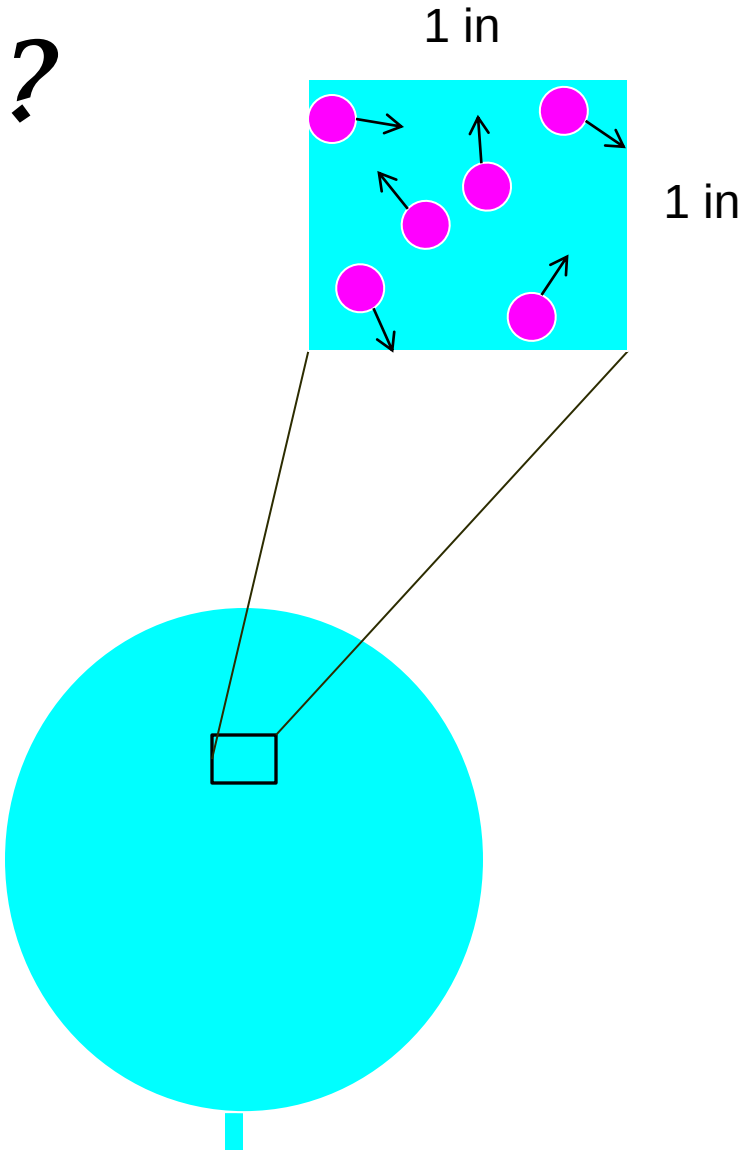
You will be able to convert between different pressure units.

What is pressure?

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Units of Pressure

1 pascal (Pa) = 1 N/m²



1atm =

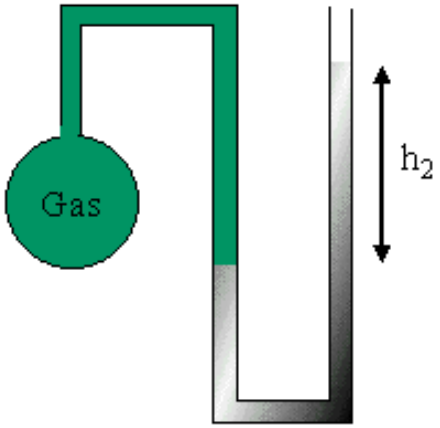
760 mmHg =

760 torr =

101.325 kPa =

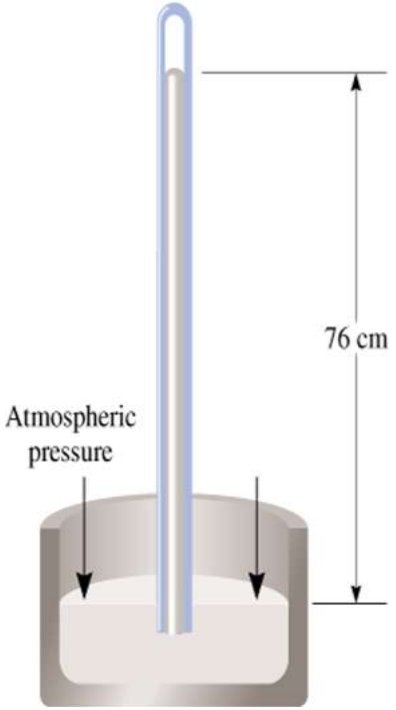
14.7psi

How do we measure pressure?



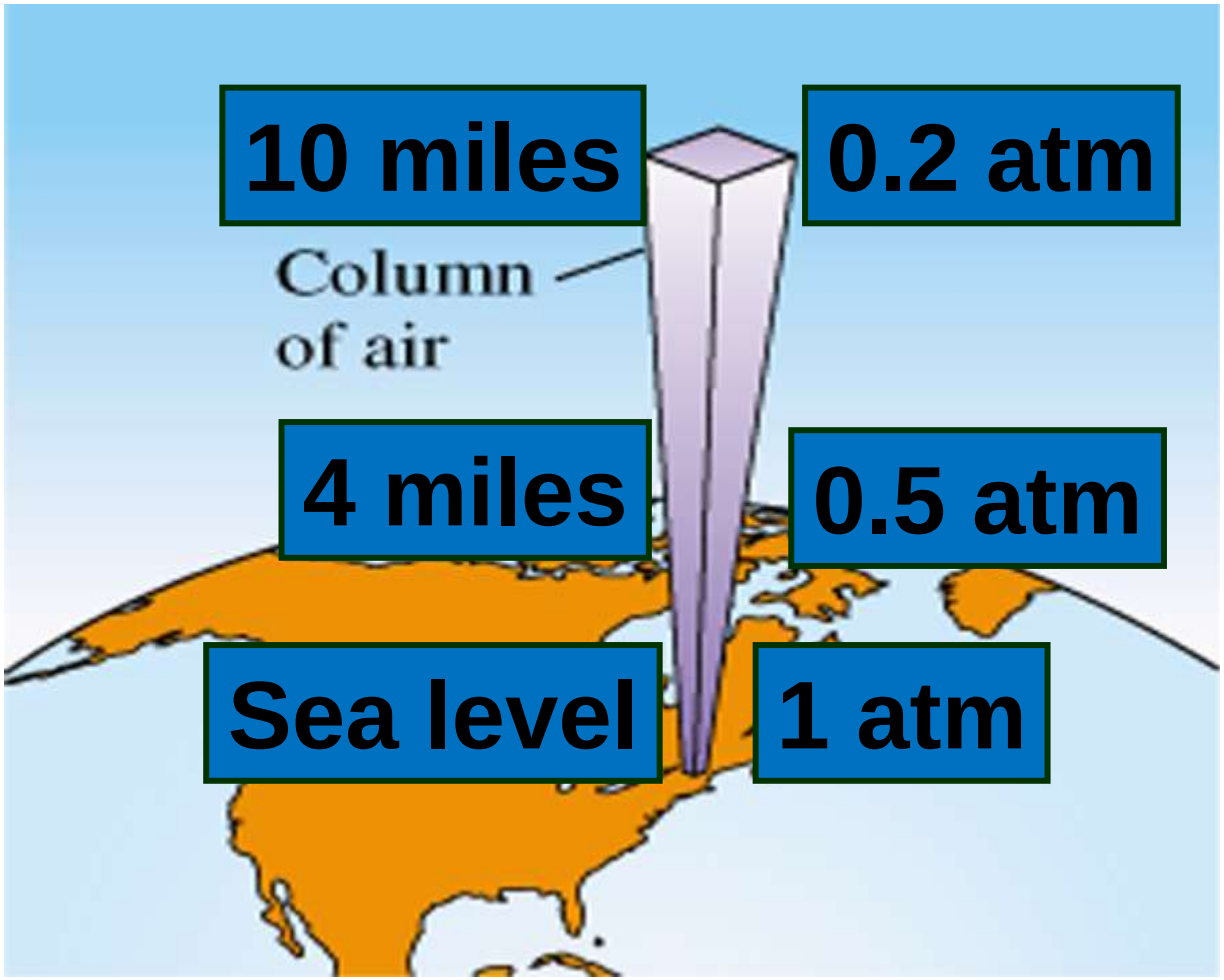
A <u>manometer</u> uses a U-shaped tube of liquid to measure pressure differences on either side of the liquid

A <u>barometer</u> uses the height of a column of mercury to measure gas pressure in mmHg



https://www.youtube.com/watch?v=EkDhlzA-lwI

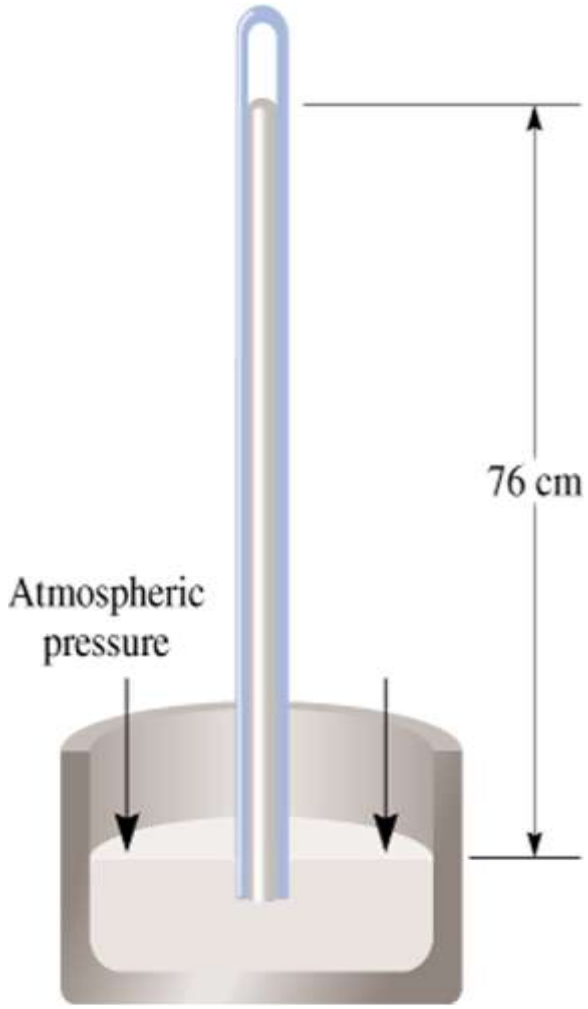
What is the pressure in mmHg at sea level?
What is the pressure in Pascals at sea level?



Try this…

Convert:

1. **727 mmHg into kPa**
2. **52.5 kPa into atm**
3. **0.729 atm into mmHg**
4. **522 torr into kPa**
5. **800.0 mmHg into atm**
6. **495Pa into mmHg**



Barometer

Standard Temperature and Pressure

Standard temperature and pressure (**STP)** refers to nominal conditions in the atmosphere at sea level. This value is important to physicists, chemists, engineers, pilots and navigators. Why?

Temperature = 0° C or 273K
Pressure = 1atm

All temperature must be converted to Kelvin

To convert ^{0}C → K

$$T\,(\mathrm{K}) = t\,(^0\mathrm{C}) + 273$$

To convert K→ ^{0}C

$$T\,(^0\mathrm{C}) = t\,(\mathrm{K}) - 273$$

Why is the Kelvin scale used exclusively in gas law calculations?

BELL WORK 7-Mar-2017

Long onto a computer and sign into Mozilla or Chrome.

Go to class web page and open the lab section.

While you wait for computer to load complete the following:

Solve the following equation for V_2:

$$P_1V_1 = P_2V_2$$

What is the equivalent pressure for a tank of compressive gas at 2.8atm if you are asked to report value in mmHg?

Computer simulation

Agenda

Objective

To explore how gases are affected by different variables using a computer simulation

Computer simulation

- From class web page in lab sections open "**PhET Gas Laws Simulation**"
- Launch the simulation

  URL:

  http://phet.colorado.edu/en/simulation/gas-properties

-OR-

- Google: "gas law PhET simulation"

Before you answering questions…

That you can…

1. Add both heavy and light gases to the container

2. Adjust the temperature of the container while holding the pressure constant

3. Decrease the volume of the container

PhET Gas Simulation Turn In

Answer all question on separate sheet of paper labeled “PhET Gas Simulation”

Compose a properly formatted email to send graphs saved to a single sheet as a pdf. and forward to Mr. Golden by 8:30am 9.Mar.2017.

Save pdf. as follows, Name: Joe Schmo, Period 1 “JoeSchmoPhETgaslawsP1”

BELL WORK 8-Mar-2017

Draw three different balloons with air particles in them

1. **One full of gas at room temperature**

2. **One full of gas at 0 °C (~32 ° F)**

3. **One full of gas at 50 °C (~122 ° F)**

Using dots show particles inside each of the balloons

Use arrows to indicate how fast they are moving (longer arrow = faster)

Rank the balloons from lowest to highest pressure

BELL WORK 9-Mar-2017

Using the gas law formula for changing volume and temperature while holding moles and pressure constant solve for V_2.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

EQ: Where else in life do we make assumption to simplify a situation?

Agenda

Gas properties and the KMT

Objective(s)

To explain properties of gases using the kinetic molecular theory

To explain to a group of peer one of the tenitis of the KMT of gasses.

PhET Gas Law Simulation

Pass it forward, time to turn in

Demo

Write on your bellwork what you predict is going to happen

Write down what you actually observed

KMT

In your assigned pairing (post it note), you will spend 5min coming up with an explanation of how the component of KMT you are assigned applies to the computer simulation or either of the demos.

Explanation should be 2-4 sentence written out.

You will present this to other students

Boyles ($P_1V_1 = P_2V_2$) and Charles Law($V_1/T_1 = V_2/T_2$)

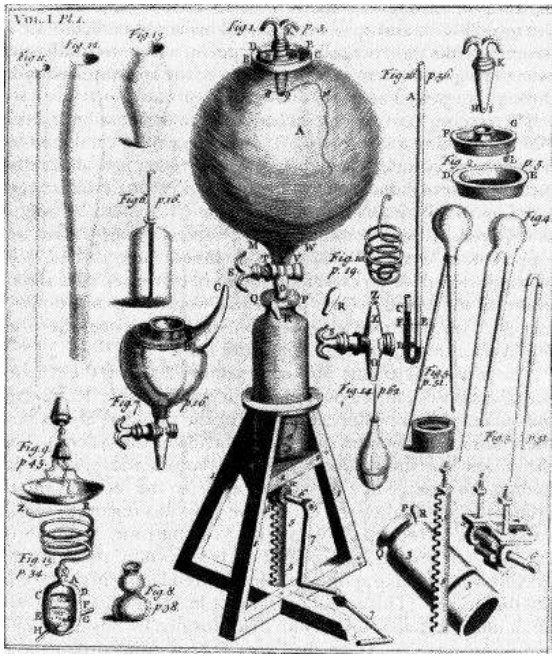
.If a gas at 25.0 °C occupies 3.60 liters at a pressure of 1.00 atm, what will be its volume at a pressure of 2.50 atm?

A gas sample at 40.0°C occupies a volume of 2.32 L. If the temperature is raised to 75.0°C, what will the volume be, assuming the pressure remains constant?

Closure

What are three (3) assumption made in the KMT of gasses regarding gas behavior and properties

Boyle's Law



Bell Work; 10.Mar.17

What is the relationship between pressure and volume if temperature and moles are held constant?

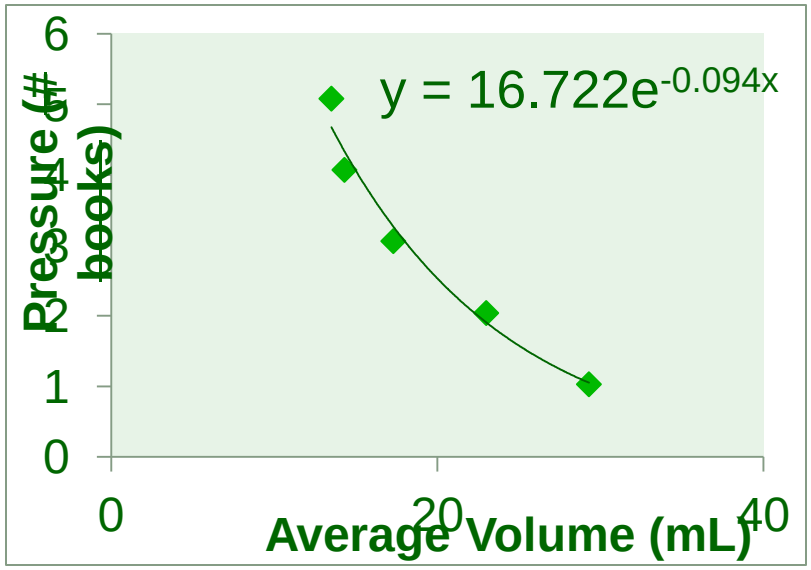
Boyles ($P_1V_1 = P_2V_2$) and Charles Law($V_1/T_1 = V_2/T_2$)

If a gas at 25.0 °C occupies 3.60 liters at a pressure of 1.00 atm, what will be its volume at a pressure of 2.50 atm?

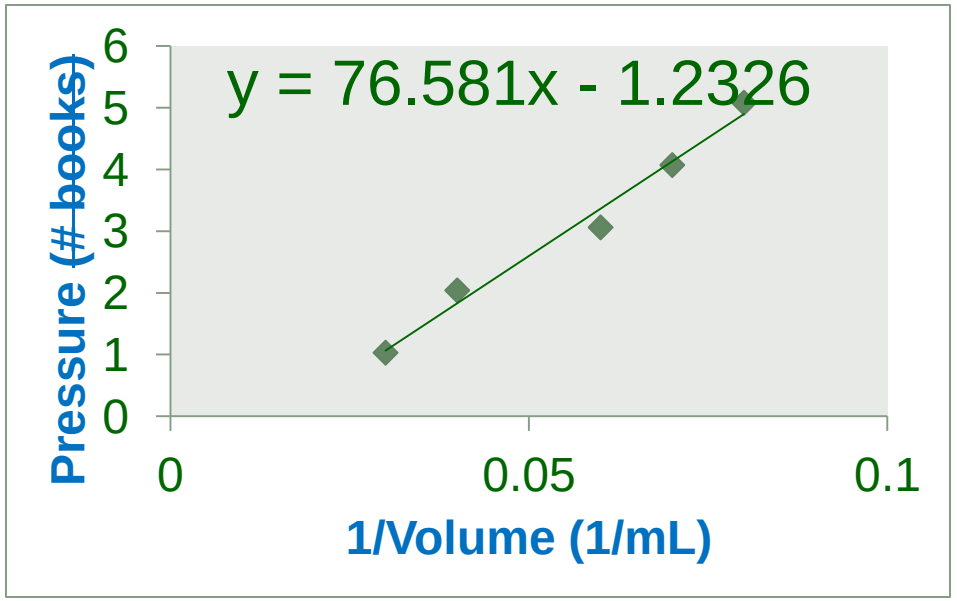
A gas sample at 40.0°C occupies a volume of 2.32 L. If the temperature is raised to 75.0°C, what will the volume be, assuming the pressure remains constant?

Boyle's Law, Data Analysis

Volume v. Pressure



1/Volume v.



When graphing V vs. P the slope is exponential (instantaneous/ not constant) so when we re-graph as V^{-1} vs. P we get a linear slope (constant)

Boyle's Law

In a system in which the amount of gas in a system stays the same and the temperature remains constant:

$$P_1V_1 = P_2V_2$$

P_1 and P_2 must be in the <u>same units</u>

V_1 and V_2 must be in the <u>same units</u>

Now Try This

At STP a sample of nitrogen takes up a volume of 50L. What is the new volume if the pressure is changed to 220 mmHg.

V_2 = ?

P_2 = 220mmHg x $\frac{1atm}{760mmHg}$ = 0.289atm

$P_1V_1 = P_2V_2$

$P_1V_1/P_2 = V_2$

V_1 = 50L

P_1 (STP) = 1atm

(1atm)(50L)/(0.289atm)= V_2

173L= V_2

Elements that exist as gases at 25˚C and 1 atmosphere

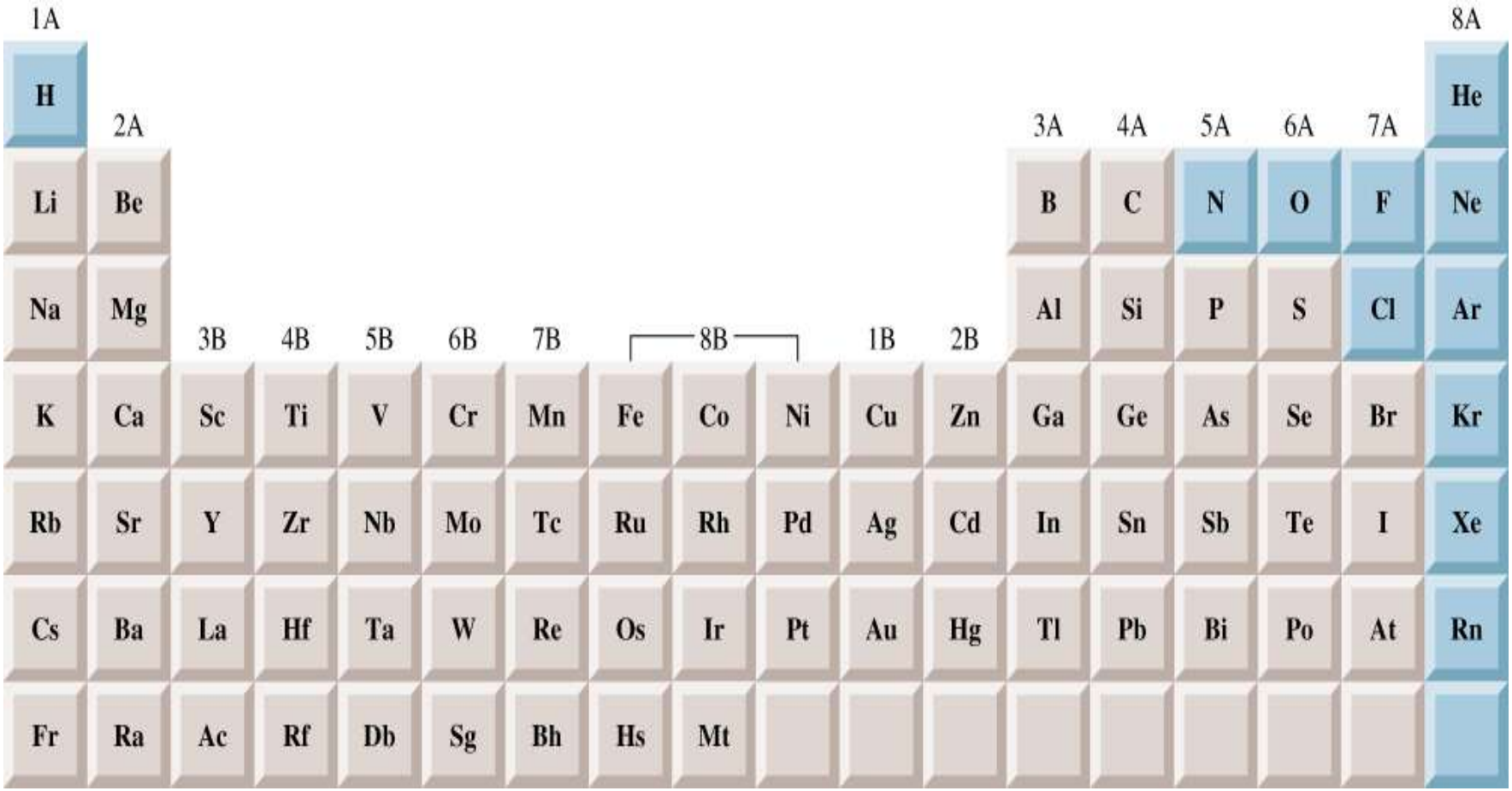


Table 5.1 Some Substances Found as Gases at 1 atm and 25°C

Elements	Compounds
H_2 (molecular hydrogen)	HF (hydrogen fluoride)
N_2 (molecular nitrogen)	HCl (hydrogen chloride)
O_2 (molecular oxygen)	HBr (hydrogen bromide)
O_3 (ozone)	HI (hydrogen iodide)
F_2 (molecular fluorine)	CO (carbon monoxide)
Cl_2 (molecular chlorine)	CO_2 (carbon dioxide)
He (helium)	NH_3 (ammonia)
Ne (neon)	NO (nitric oxide)
Ar (argon)	NO_2 (nitrogen dioxide)
Kr (krypton)	N_2O (nitrous oxide)
Xe (xenon)	SO_2 (sulfur dioxide)
Rn (radon)	H_2S (hydrogen sulfide)
	HCN (hydrogen cyanide)*

** The boiling point of HCN is 26°C, but it is close enough to qualify as a gas at ordinary atmospheric conditions.*

Try Again using "Box Method"

4.35 L of a gas is at 1.16 atm. What pressure is obtained when the volume is 9.3 L?

1. What you want?	
2. Given Information	4. Plan
	5. Calculations for solutions
3. Useful formulas/ conversions	

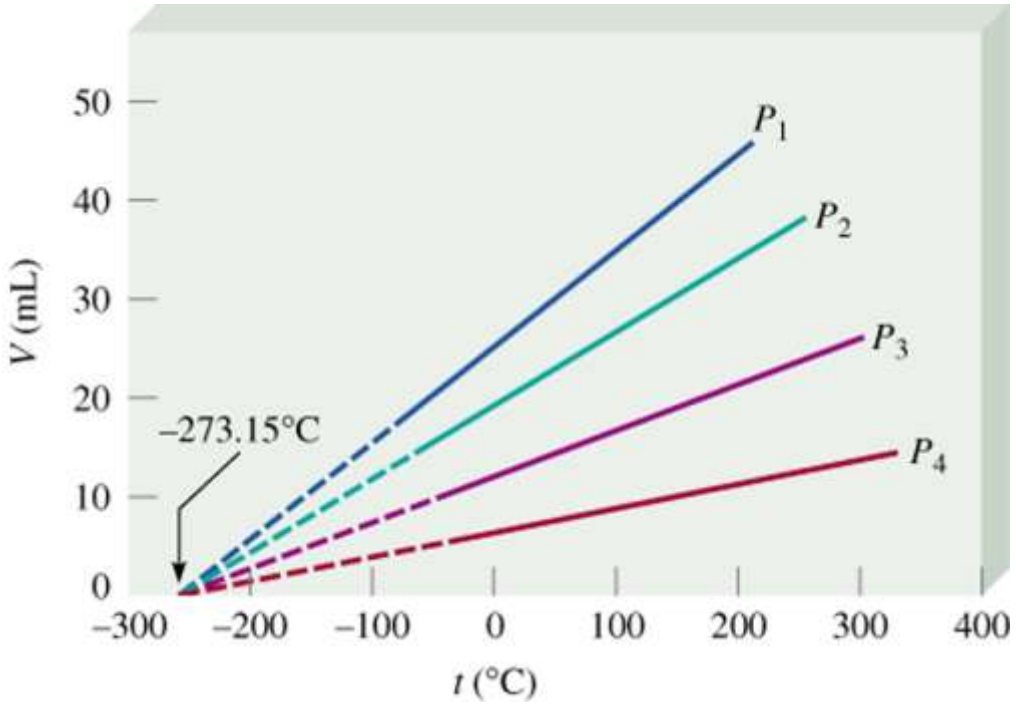
Charle's Law Lab

(at least) Four data points:

1. **One at room temperature (record the temperature)**
2. **One using 600 mL of the ice water in the cooler (make sure not to grab any ice)**
3. **One using 300mL ice water and 300 mL tap water**
4. **On at least <u>ten degrees higher</u> than room temperature (*beginning warming water as soon as you get to your lab*)**

****Do more if you have time**

Charles law?



Charles' Law

$$V \propto T$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\text{\% Error} = \left| \frac{\text{Theoretical Value} - \text{Experimental Value}}{\text{Theoretical Value}} \right| \times 100$$

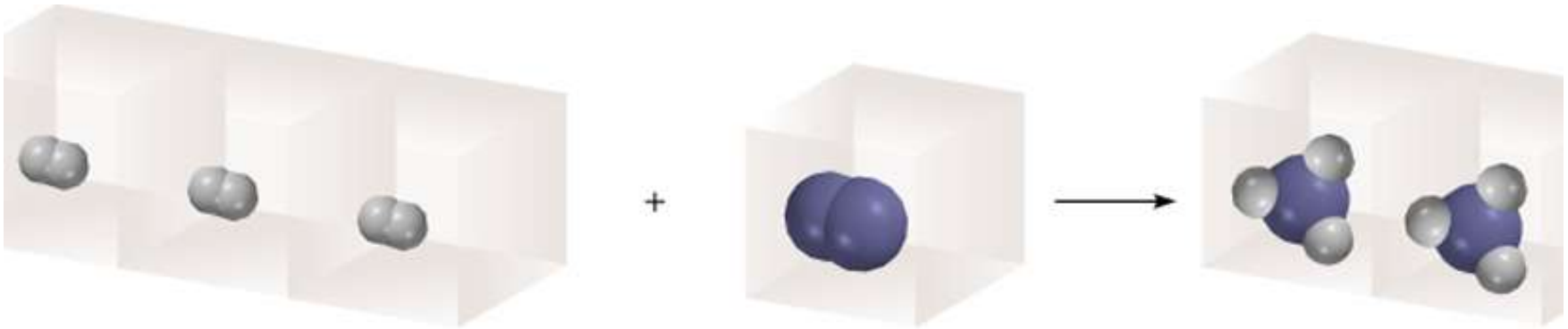
Avogadro's Law

$V \alpha$ number of moles (n)

V = constant x n

Const. Temp.
Const. Pressure

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$



$3H_2\ (g)$	+	$N_2\ (g)$	⟶	$2NH_3\ (g)$
3 molecules	+	1 molecule	⟶	2 molecules
3 moles	+	1 mole	⟶	2 moles
3 volumes	+	1 volume	⟶	2 volumes

Gas Law Practice #1

Boyle's Law Problem (#1-5):

Boyle's Law Problem with conversions (#6-11):

Charles's Law Problems, (#12-21):

Homework: Complete over weekend show all work for credit, answers are provided ☺

ACTIVITY!

- Two (2) sets of eight stations
- Two (2) people per station at a time
- One (1) prompt per station
- Three (3) minutes per prompt
- Individual answer sheets on a separate piece of paper

ACTIVITY!

For each situation explain:

1. **What gas properties are being observed (use your notes)**

2. **How do you explain these properties using the KMT (use your notes)**

3. **Give another example in which you observe the same situation**

Exit Slip

1. **List the six postulates of the Kinetic Molecular Theory.**

2. **State which one you see at play most in your every day life and give an example of how you see it.**

Bellwork 14 Mar 16

On a spring break trip to the lake you attempt to blow up a beach ball when the temp. was at 15°C. Half way through you gave up leaving the beach ball at a volume of only 3.0L. Later in the day you return to when the temp. was at 30°C, what happened to the volume of your beach ball assuming pressure and mole remain constant?

a. Describe what happened using the KMT and properties of gases *and* do the calculation.

b. What would be the diameter of the beach ball at the 30°C temperature?

c. If the ball weighted 78g and the air in side at 30°C weighted 3.77 what is the density if the air (gas) in g/L?

Bellwork 03/13/17

5.00L of H_2 gas is at a pressure of 877.0 mmHg:

1. What is the pressure of the gas in Pascals?
2. If the volume were increased to18.0L what would the new pressure be in atm?
3. How would the original pressure be different if the gas used was SF_6 instead of hydrogen? **Why?**
4. **Report the air pressure in the room in atm if the meter read 30.07inHg (in = inches, 2.54cm = 1.0in**

https://www.youtube.com/watch?v=1PJTq2xQiQ0

EQ: After you learn something that was "difficult" why is it now easy?

Agenda

Dalton's Law of Partial Pressures

Combined Gas Law/Problem solving box

Objectives

- You will apply Dalton's Law of Partial Pressures and be able to carry out calculations
- You will be able to determine which equation to use given a word problem.

Recall

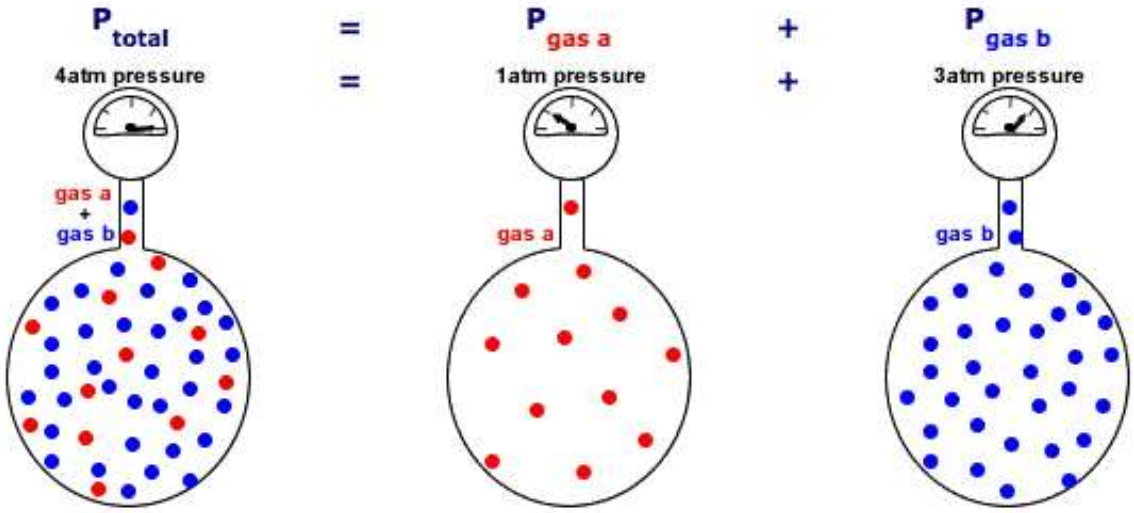
1. **Octane (gas) reacts with oxygen to form CO_2(g) and water vapor (see below). If 3,000.0 g of octane is burned how much CO_2 is formed during the reaction?**

$$2\,C_8H_{18(l)} + 25\,O_{2(g)} \longrightarrow 16\,CO_{2(g)} + 18\,H_2O_{(g)}$$

1. **Solve Boyle's law for P_2.**
2. **A sample of chlorine gas occupies a volume of 946.0mL at a pressure of 726.0mmHg. What is the pressure of the gas (in mmHg) if the volume is decreased to 154.0 mL?**

Dalton's Law of Partial Pressures

At a constant volume and temperature the total pressure exerted by a <u>mixture</u> of gases is equal to the <u>sum</u> of their individual pressures



$$P_{total} = P_1 + P_2 + P_3 \ldots P_n$$

Try This

The air around us contains oxygen, nitrogen, carbon dioxide, and trace amounts of other gases. What is the partial pressure of oxygen at 101.3 kPa of pressure if P_{N2} = 79.1 kPa, P_{CO2} = 0.04 kPa, and P_{others} = 0.94 kPa?

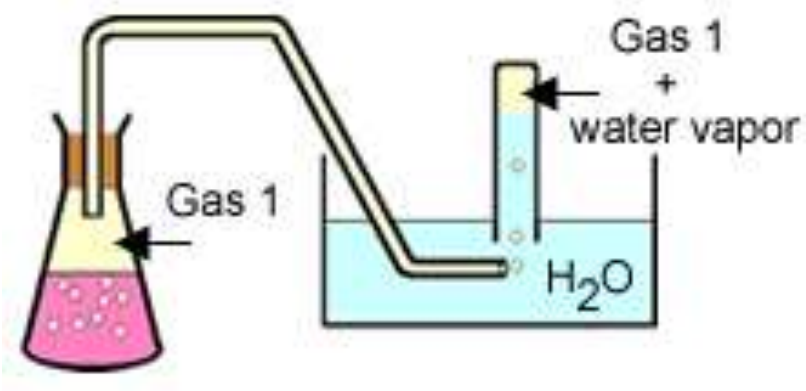
Dalton's Law of Partial Pressures

When collecting a gas over water you need to account for the "Vapor pressure" of water at the collection temperature.

To find the pressure of the dry gas alone, we need to subtract out the pressure of the water vapor.

$$P_{total} = P_{dry\ gas} + P_{water\ vapor}$$

$$P_{dry\ gas} = P_{total} - P_{water\ vapor}$$



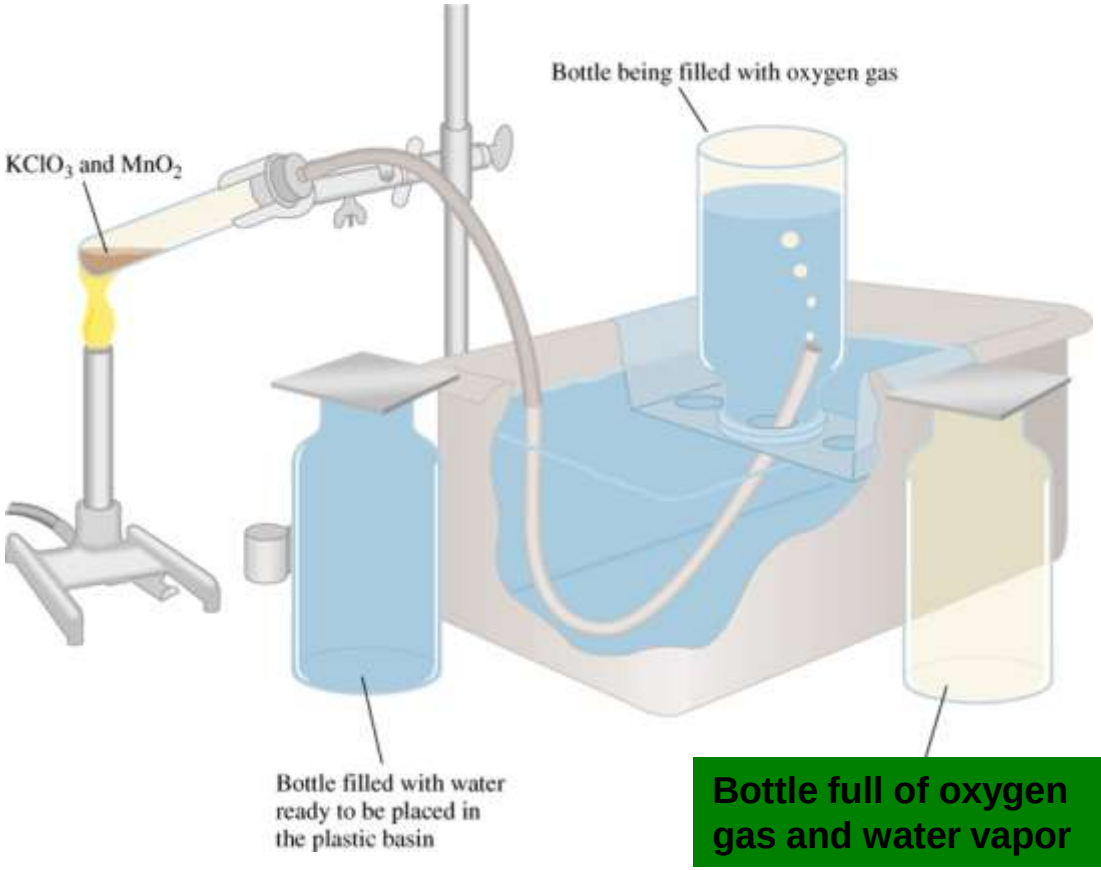


Table 5.3 Pressure of Water Vapor at Various Temperatures

Temperature (°C)	Water Vapor Pressure (mmHg)
0	4.58
5	6.54
10	9.21
15	12.79
20	17.54
25	23.76
30	31.82
35	42.18
40	55.32
45	71.88
50	92.51
55	118.04
60	149.38
65	187.54
70	233.7
75	289.1
80	355.1
85	433.6
90	525.76
95	633.90
100	760.00

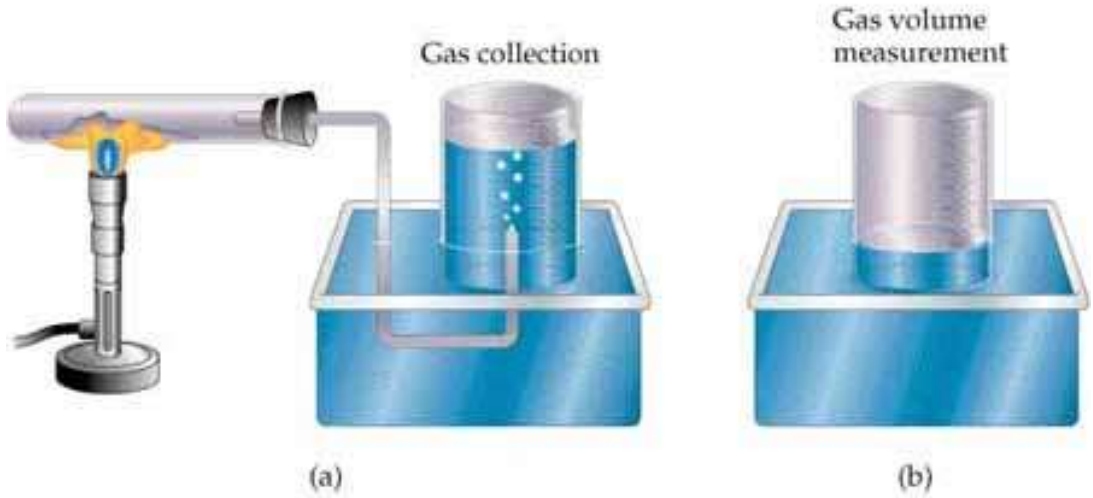
$$2KClO_3\,(s) \rightarrow 2KCl\,(s) + 3O_2\,(g)$$

$$\boldsymbol{P_T = P_{1O_2} + P_{2H_2O}}$$

Dalton's Law of Partial Pressures

A common method of gas collection in the laboratory involves displacing water from a bottle, so that you know when the bottle is full of an invisible gas.

The gas that is left in the bottle will not be pure, it will be a mixture that contains a certain amount of water vapor.



Demo

$2\ Al + 2\ NaOH + 2\ H_2O \rightarrow 2\ NaAlO_2 + 3\ H_2$

We will react 2.0g Al with excess NaOH,

Table 5.3 Pressure of Water Vapor at Various Temperatures

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55	118.04
60	149.38
65	187.54
70	233.7
75	289.1
80	355.1
85	433.6
90	525.76
95	633.90
100	760.00

Water Vapor Pressure (torr)							
T(°C)	*P*	*T*(°C)	*P*	*T*(°C)	*P*	*T*(°C)	*P*
0	4.58	21	18.65	35	42.2	92	567.0
5	6.54	22	19.83	40	55.3	94	610.9
10	9.21	23	21.07	45	71.9	96	657.6
12	10.52	24	22.38	50	92.5	98	707.3
14	11.99	25	23.76	55	118.0	100	760.0
16	13.63	26	25.21	60	149.4	102	815.9
17	14.53	27	26.74	65	187.5	104	875.1
18	15.48	28	28.35	70	233.7	106	937.9
19	16.48	29	30.04	80	355.1	108	1004.4
20	17.54	30	31.82	90	525.8	110	1074.6

Dalton's Law of Partial Pressures

A sample of H_2 gas is collected over water at 14.0^{o}C, vapor pressure of H_20 at 14^{o}C is1.6kPa. The pressure of the resultant mixture is 113.0kPa. What is the pressure that is exerted by the dry H_2 alone?

$P_{dry\ gas}$ = ?
P_{total} = 113.0 kPa
$P_{water\ vapor}$ = 1.6 kPa

$P_{dry\ gas} = P_{total} - P_{water\ vapor}$

$P_{H2} = 113.0\ kPa - 1.6\ kPa$